Pahala Wastewater Treatment Plant Preliminary Engineering Report

Prepared for

County of Hawaii, Department of Environmental Management

August 2017

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List of Abbreviations

AB	aggregate base
AC	asphaltic concrete
BOD_5	5-day biochemical oxygen demand
DOH	Department of Health
FOG	fats, oils, and grease
ft^3	cubic feet
gpm	gallons per minute
HAR	Hawaii Administrative Rules
HDPE	high density polyethylene
HELCO	Hawaii Electric Light Company
hp	horsepower
hr	hour
L	liter
lbs.	pounds
LCC	large capacity cesspool
mg	milligrams
Mgal	million gallons
mm	millimeter
ROW	right-of-way
RPP	reinforced polypropylene
scfm	standard cubic feet per minute
SR	slow rate
TSS	Total suspended solids
USEPA	United States Environmental Protection Agency
UV	ultraviolet light
WWTP	wastewater treatment plant

Section 1

Introduction

1.1 Background

The town of Pahala is located in the Kau district of the Island of Hawaii. According to the 2010 United States Census, the town population is approximately 1,350 persons.

The Pahala community was established as the result of the sugar operations of the C. Brewer Company. Most of the residents of Pahala are serviced by a sewer system that was privately built, owned, and operated by the C. Brewer Company. The wastewater collected by the sewer system discharges into large capacity “gang” cesspools. Many years after its establishment, the private sewer system ownership was conveyed to the County of Hawaii.

In 1998, the U.S. Environmental Protection Agency (USEPA), promulgated regulations, 40 CRF 144.14, which requires the elimination of large capacity “gang” cesspools (LCCs). The County intends to construct a new sewer collection system located within public right-of-way (ROWs) and replace the existing LCCs with a wastewater treatment plant to address the wastewater treatment and disposal needs of the Pahala community.

This report summarizes a proposed wastewater treatment plant (WWTP) needed in order to treat and dispose of the wastewater flow that is currently discharged to the LCCs, plus additional sewer connections. The report presents the existing and estimated future flows and loads to the treatment plant, the proposed treatment processes, recommendation for the WWTP upgrades needed to meet the future treatment needs, and an initial opinion of the cost to construct the improvements project.

Section 2

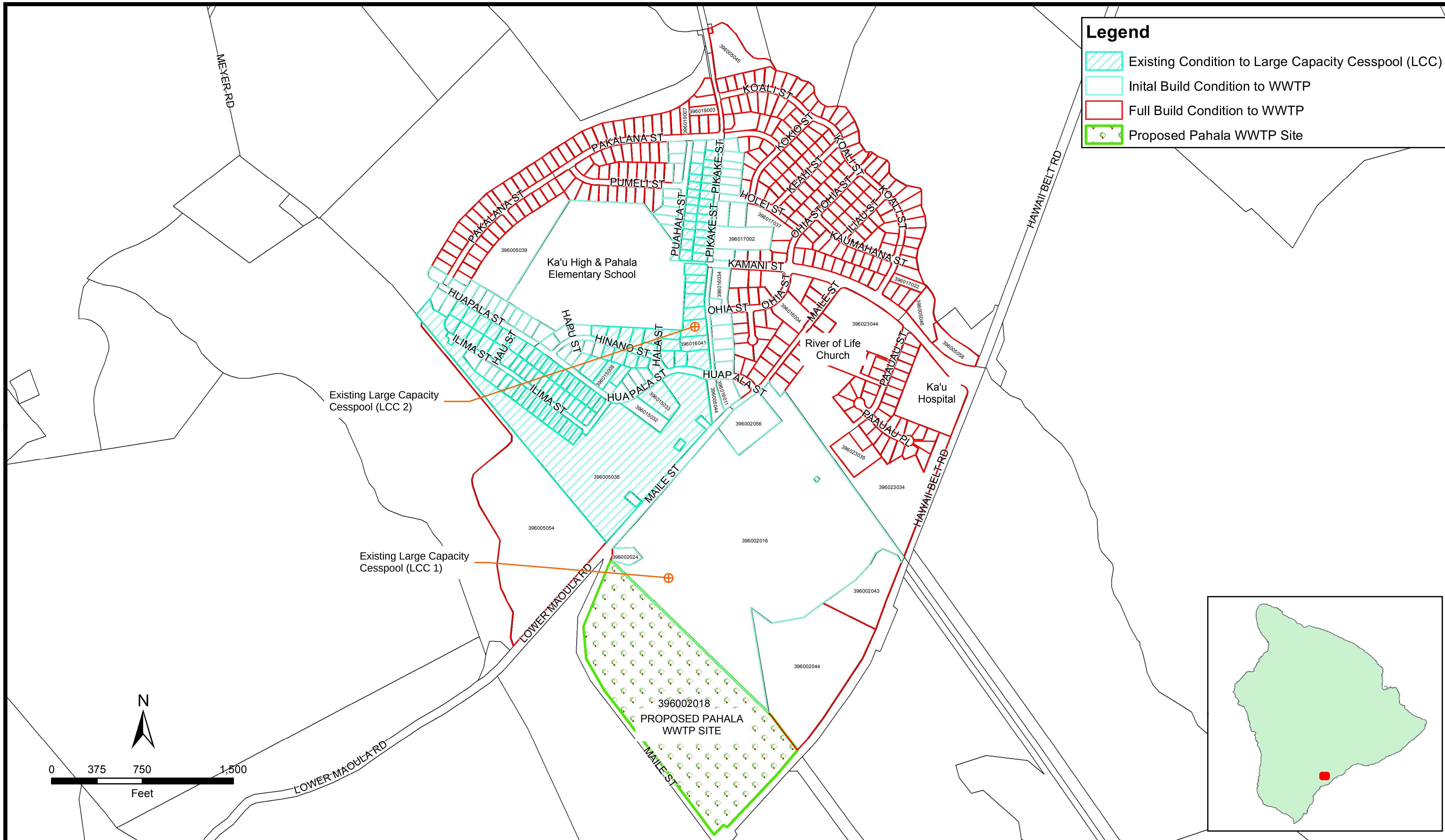
Flow and Load Projections

This section summarizes the flow and load projections for the new WWTP.

2.1 Service Area

Within the town of Pahala, there is an existing wastewater collection that services approximately 109 properties. The collection system is currently located in private property and is treated and disposed through two LCCs. Figure 2-1 shows the service area for the new WWTP. The Kau Community Development plan indicates that the sewer system may eventually be expanded to service the entire community; however, the initial collection system and WWTP presented in this report will only service the properties currently connected to the LCCs or located adjacent to the collection system.

Figure 2-2 shows the collection system network and service areas for the LCCs. The collection system is an extensive network of gravity sewers that discharge to two existing LCCs. A detailed analysis of the existing wastewater collection system was completed by others (M&E Pacific, December 2004). The report concluded that the Pahala community existing sewer system consist of about 3,000 linear feet of 6-inch diameter and 10,000 linear feet of 4-inch diameter pipelines. Residential laterals connect to 4-inch sewers that discharge into 6-inch sewer mains, predominately found in private property, which transmit wastewater to the LCCs. There are only 3 to 5 manholes in the sewer system. One of the most prominent manholes is located near the commercial establishments on Pikake Street. There are no pump stations and the system is not designed to collect stormwater.



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PAHALA WASTEWATER TREATMENT PLANT

PAHALA WWTP SERVICE AREA

FIGURE

2-1

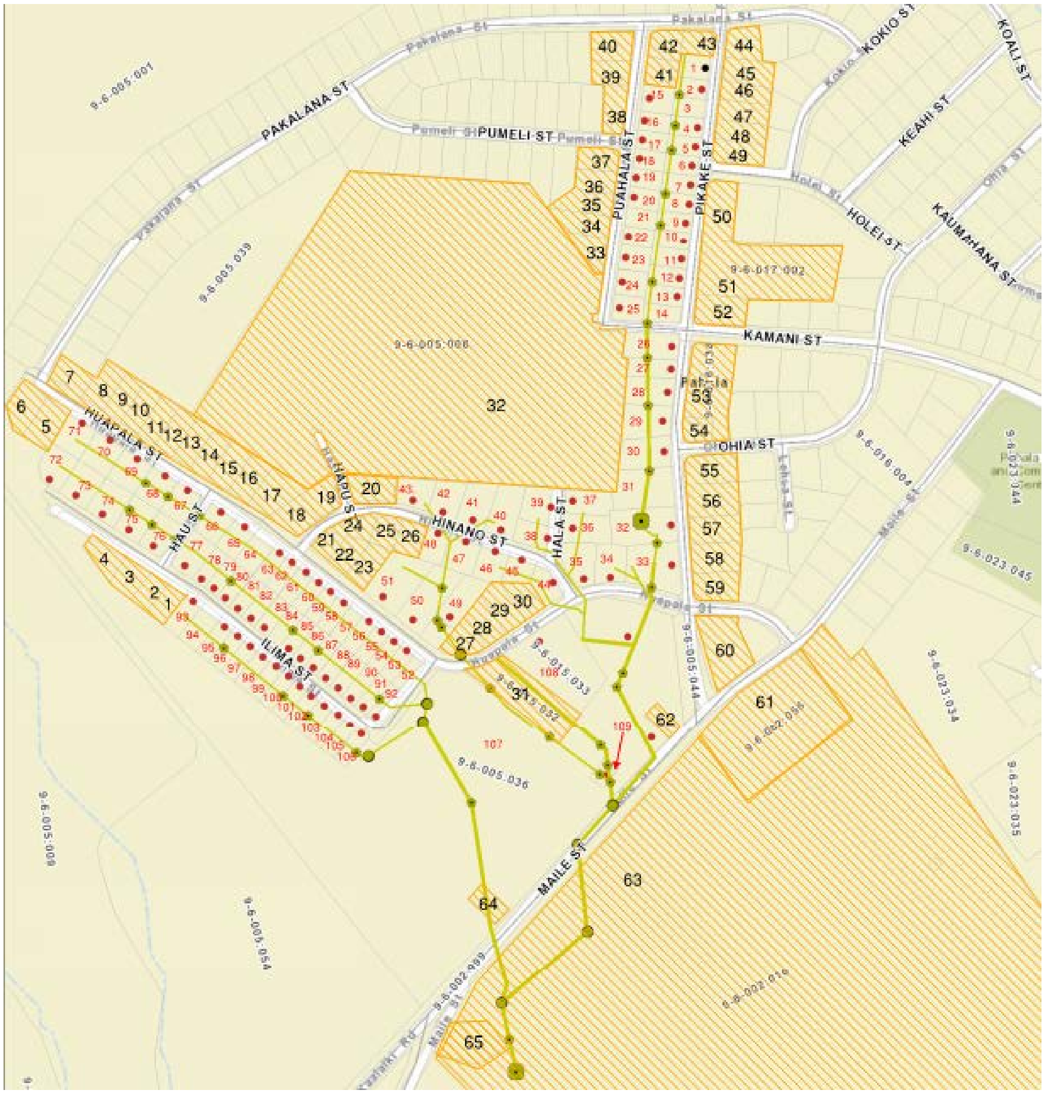


Figure 2-2. Pahala Existing Sewer Collection System

2.2 Flow Projections

Wastewater flow projections were developed using the City and County of Honolulu's current (2017) wastewater standards. Table 2-1 summarizes the flow projections.

Table 2-1. Pahala WWTP Flow Projections		
Description	Value	Peaking Factor
Average dry weather flow	189,000 gallons per day	1.0
Peak day wet weather flow	662,000 gallons per day	3.5
Peak hour wet weather flow	900,000 gallons per day	4.8

The WWTP will be designed to provide an average dry weather flow capacity of 200,000 gallons per day to provide a flow contingency.

2.3 Influent Characteristics

The properties within the existing service area are primarily residential, but do include several commercial, apartment, and industrial zoned parcels. The wastewater characteristics of the WWTP influent are assumed to be similar to typical domestic wastewater. Table 2-2 provides a summary of the assumed influent characteristics.

Table 2-2. Summary of Influent Characteristics

Parameter	Value
5-day biochemical oxygen demand (BOD_5)	350 mg/L
Total suspended solids (TSS)	350 mg/L
Total nitrogen	40 mg/L
Total phosphorus	7 mg/L

2.4 Influent Mass Loads

Table 2-3 summarizes the projected loads to the WWTP, based on the proposed average dry weather capacity of 200,000 gallons per day and the influent characteristics presented in Table 2-2.

Table 2-3. Projected Influent Mass Loads

Description	Value
BOD_5	584 lbs./day
TSS	584 lbs./day
Total nitrogen	67 lbs./day
Total phosphorus	12 lbs./day

Section 3

Effluent Management Options and Regulatory Requirements

Effluent management options are evaluated in this section, followed by an assessment of regulatory requirements for the recommended effluent management system.

3.1 Effluent Management Options

Effluent management options are evaluated below.

3.1.1 Ocean Discharge

Ocean discharge of treated effluent is not considered a viable option for this small community due to the high cost to construct an outfall, stringent water quality standards, high receiving water monitoring cost, and difficulty and length of time required to secure the required permits.

3.1.2 Subsurface Disposal via Injection Wells

Disposal to groundwater via an injection well is not a viable option because the town is located mauka of the State of Hawaii Department of Health (DOH) Underground Injection Control line.

3.1.3 Water Recycling

An irrigation assessment was prepared to assess the viability of water recycling as the primary effluent management system. Figure 3-1 is a summary of the assessment that shows there is typically no irrigation demand for six months of the year due to high rainfall. In addition, the DOH requires that all water recycling programs have a 100 percent backup disposal system in place to handle flow that does not meet recycled water quality standards or when recycled water supply exceeds demand. Therefore, water recycling is not a viable primary effluent management strategy for the community, however water recycling treatment, storage, and distribution systems could be added in the future.

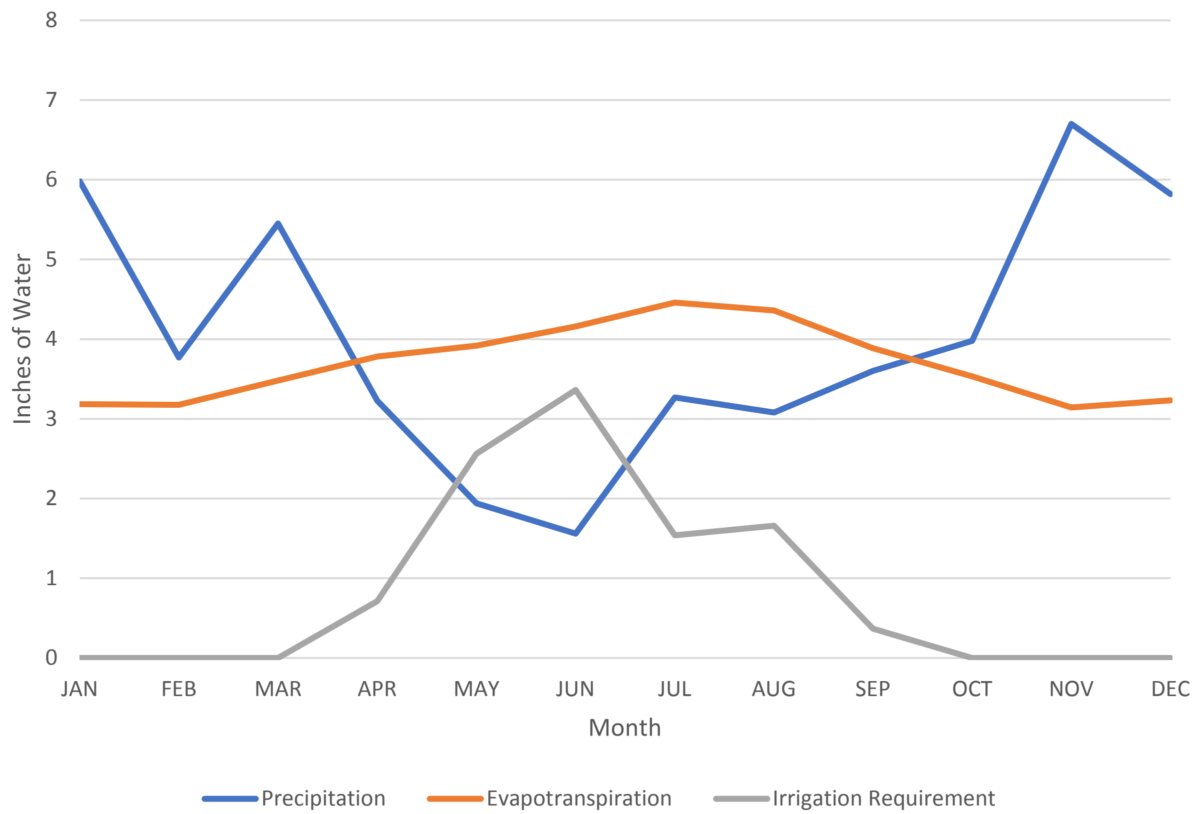


Figure 3-1. Irrigation Demand Assessment

3.1.4 Land Treatment

The USEPA defines land treatment as "the application of appropriately pre-treated municipal and industrial wastewater to the land at a controlled rate in a designed and engineered setting. The purpose of the activity is to obtain beneficial use of these materials, to improve environmental quality, and to achieve treatment goals in a cost-effective and environmentally sound manner" (USEPA, September 2006).

Land treatment systems rely on soil and vegetation to achieve treatment objectives, rather than energy-intensive mechanical equipment. As such, they are considered to be a form of "natural" treatment (Crites, et. al., 2014).

Land treatment is not a new concept. "Land application of wastewater was the first 'natural' technology to be rediscovered (after passage of the Clean Water Act of 1972). In the 1840s in England, it was recognized as avoiding water pollution as well as returning nutrients in wastewater back to the land. In the 19th century it was the only acceptable method for waste treatment, but it gradually slipped from use with the invention of modern devices" (Crites, et. al., 2014).

The soils at the proposed WWTP location are suitable for slow rate (SR) land treatment. SR land treatment consists of irrigation of land and vegetation with effluent. Significant treatment is provided as the water percolates through the soil. The vegetation uses the nutrients in the effluent as fertilizer, and transpires a portion of the applied water.

3.1.5 Drain Field

A drain field (i.e., leach field) could potentially be constructed for subsurface disposal of treated effluent. Preliminary assessment of the concept based on the site soil characteristics indicate approximately 20,000 linear feet of drain field trench would be required to accommodate the anticipated flow. It would be difficult to evenly distribute effluent throughout a drain field of this size. In addition, DOH regulations require a redundant drain field for subsurface disposal systems, making this option expensive to implement. This option is considered impractical for the community.

3.1.6 Recommendation

A slow rate land treatment system is recommended for effluent management for the community.

3.2 Treatment Requirements

The DOH regulates land treatment as “land disposal” per Hawaii Administrative Rules (HAR) 11-62. Table 3-1 lists the applicable effluent requirements for land disposal.

Table 3-1. HAR 11-62 Land Disposal Requirements

Parameter	Value
BOD_5	30 mg/L monthly average 60 mg/L peak
TSS	30 mg/L monthly average 60 mg/L peak

Section 4

Wastewater Treatment Plant Preliminary Design

This section presents the preliminary design of the proposed WWTP.

4.1 Preliminary Treatment

The preliminary treatment system will include screening, influent flow measurement, and influent sampling equipment.

4.1.1 Screening

Screening is recommended to protect the downstream system operations from large objects, debris, and rags that can be present in wastewater. Aerated lagoon treatment systems require a minimum of coarse screens to protect the aeration equipment. The industry trend is towards finer screening systems that remove greater amounts of debris from the waste stream; screens with 6 millimeter (mm) (¼ inch) openings are frequently used for activated sludge treatment systems. An aerated lagoon treatment system can benefit from ¼ inch screening to reduce the amount of floatable debris on the lagoon shoreline, creating a cleaner facility that is less attractive to birds. Since the Pahala WWTP will not be continuously staffed, a screening process requiring minimal attention is desirable. Furthermore, the screenings volume is expected to be small, subsequently screenings disposal is expected to be infrequent; weekly at most. Therefore, the screenings must be washed of organic debris to prevent the accumulation of nuisance odors and flies in the screenings barrel or bag between screening disposal events.

4.1.1.1 In-channel cylindrical screen

We recommend an in-channel cylindrical screen for this installation. The in-channel cylindrical screen combines screening, screenings washing, dewatering, compacting, and bagging/disposal within a single unit. The screening portion consists of an inclined screen basket inserted into the wastewater channel. The screening basket can consist of bars, perforated plates or sieves, depending on the application and clear opening required. The controls can be set to allow a mat to build up on the screening surface, allowing finer screening of the wastewater. Controlled by head loss, a rake arm starts rotating within the screen basket, pushing the screenings off the rake and into a perforated screenings hopper located at the screen's central axis. A shafted auger along the screen axis conveys the screenings from the hopper through an inclined tube, which dewaters and compacts the screenings. The tube includes a perforated dewatering section. The discharged screenings are about 40-percent dry, and can be discharged into a bin or directly into a bagging system. Figure 4-1 illustrates the process. Manufacturers include Lakeside and Huber. The key benefit to this system is the integrated screenings washing system, minimizing additional screenings handling and odor potential.

For this installation, the headworks will include two in-channel cylindrical screens, one will be on-line when the other is redundant, plus a bypass channel with manually cleaned bar rack.

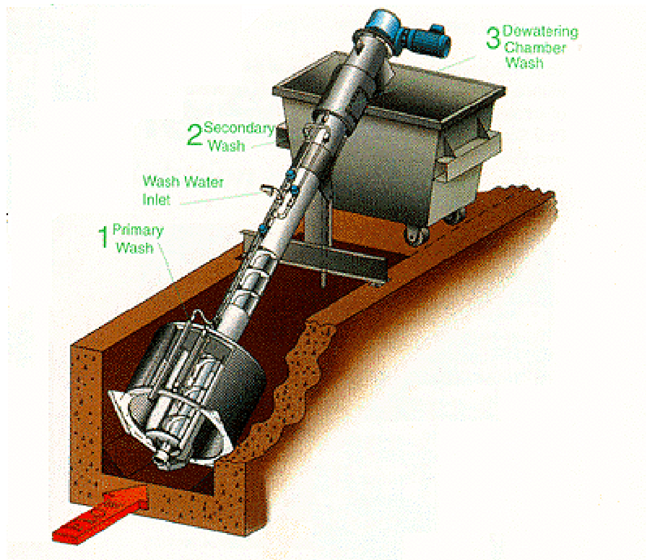


Figure 4-1. In-channel Cylindrical Screen

4.1.2 Influent Flow Measurement

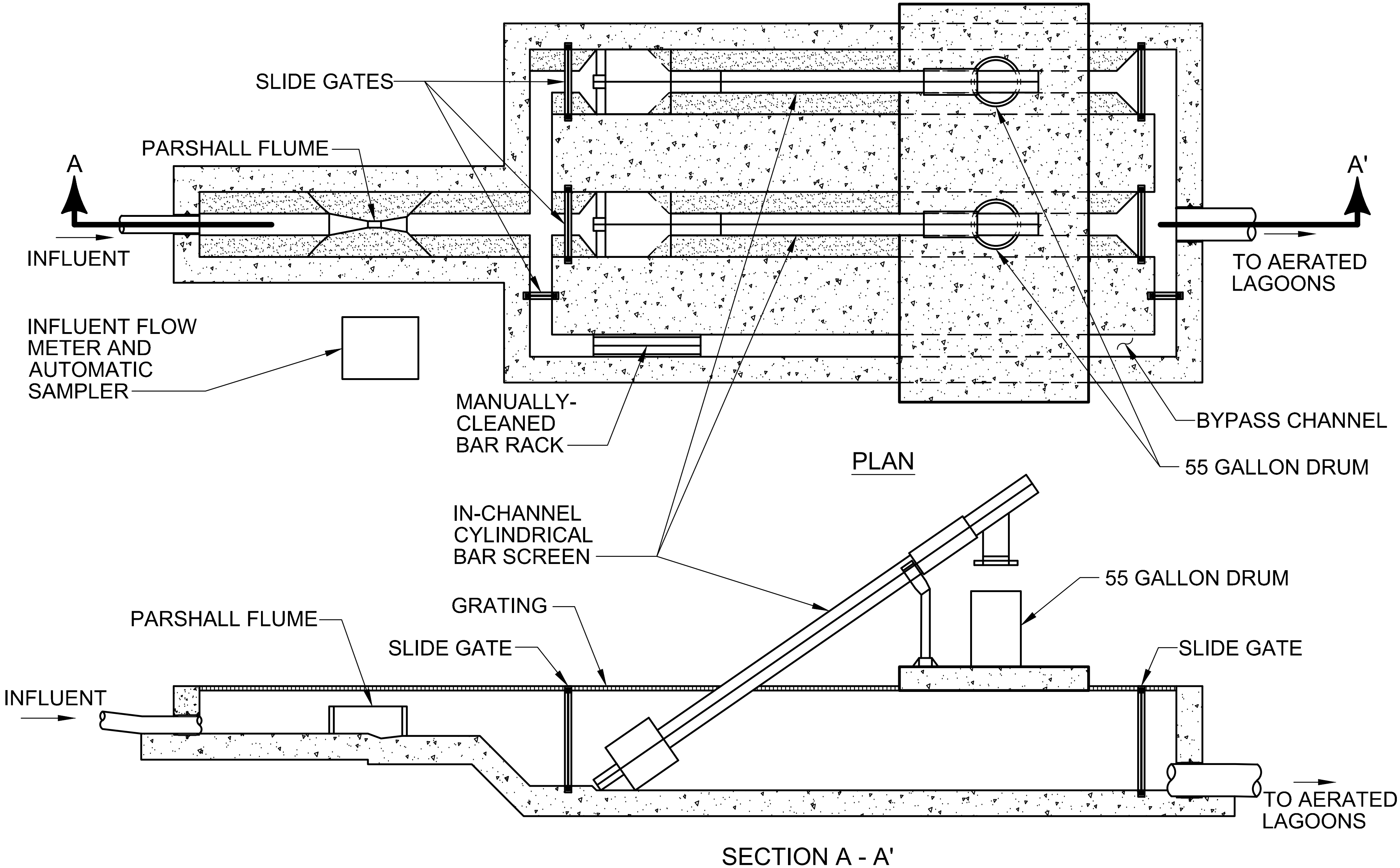
Influent flow measurement is recommended to allow assessment of flows and loads to the biological treatment process, and to assess the biological treatment process performance. A Parshall flume will be provided upstream of the screening system to continuously record influent flow rates. Parshall flumes work well for influent measurement because the flume can operate in an open-channel configuration, can accommodate wide ranges of flows, and is self-cleaning. A straight approach length of at least 20 times the flume throat width will be provided upstream of the flume to provide favorable hydraulic conditions.

4.1.3 Influent Flow Sampling

An automatic refrigerated composite sampler is recommended to allow influent composite samples to be collected. Influent composite samples, when combined with influent flow measurement, can be used to calculate influent mass loading rates to the WWTP to assess the treatment performance and optimization of aeration rates in the biological treatment process. Periodic influent sampling is also recommended to monitor for changes in the influent characteristics.

4.1.4 Preliminary Design of Headworks

Figure 4-2 shows a plan and section of the proposed headworks. Influent wastewater will enter the upstream end of the headworks channel. Stop plates will be used to divert the flow to one of the two the in-channel cylindrical screens, or to the manually-cleaned bar rack. The slide gates will be designed to allow automatic overflow to the other channels in the event of mechanical screen failure. The washed and compacted screenings will be deposited in a bag or 55-gallon drum for periodic disposal. The Parshall flume and automatic refrigerated composite sampler will be located upstream of the screens.



Brown AND Caldwell	SCALE: JOB NO: 150440 DATE: AUGUST 2017	PAHALA WASTEWATER TREATMENT PLANT HEADWORKS	FIGURE 4-2

4.2 Aerated Lagoon Treatment System

The biological wastewater treatment needs at the Pahala WWTP will be met by a series of aerated lagoons. A floating cover will be installed on the last cell to reduce algae in the effluent. The preliminary design of the aerated lagoon treatment system is developed in this section.

4.2.1 Aerated Lagoon Kinetics

The Pahala WWTP design is reliant on both partial mix and complete mix aerated lagoon environments to provide the community's wastewater treatment needs through buildout conditions. Partial mix and complete mix aerated lagoon kinetics are described below.

4.2.1.1 Partial mix model

Partial mix aerated lagoons are based on the concept of allowing solids to settle in lagoons while providing only enough aeration and mixing to meet the oxygen requirements of the naturally occurring micro-organisms in the system. The solids tend to settle in areas of the lagoon that are subject to less mixing energy, where they anaerobically decompose. Infrequent sludge removal is required to maintain sufficient lagoon treatment volume.

Removal of BOD_5 in partial-mix aerated lagoons depends on the hydraulic detention time. The design model for partial mixed ponds of equal size in series is (Crites, et. al., 2006):

$$\frac{Cn}{Co} = \frac{1}{[1+(kt/n)^n}$$

Where Cn = effluent BOD_5 concentration in cell n, mg/L

Co = influent BOD_5 concentration, mg/L

k = partial-mix first-order reaction rate constant, day^{-1}

t = total hydraulic residence time in the lagoon system, day

n = number of cells in the series

If the lagoons in a system are of unequal size, then the equation must be applied to each lagoon in the series. The Ten-States Standards recommends using a value of 0.276 day^{-1} at 20 ºC for the reaction rate constant (Great Lakes – Upper Mississippi River Board, 1997).

4.2.1.2 Complete mix model

In a complete mix aerated lagoon sufficient mixing energy is provided to maintain the lagoon solids in suspension at all times. A completely mixed aerated lagoon system is, in essence, an activated sludge process without solids recycle. The higher mixing energy (as compared to a partial mix lagoon) creates greater opportunity for contact between the naturally-occurring micro-organisms in the lagoon and dissolved organic matter. As a result, complete mix lagoons are capable of providing greater levels of treatment within a smaller volume than partial mix lagoons.

The design model for complete mix lagoons of equal size in series is (Crites, et. al., 2006):

$$\frac{Cn}{Co} = \frac{1}{[1+(kt/n)^n}$$

Where Cn = effluent BOD_5 concentration in cell n, mg/L

Co = influent BOD_5 concentration, mg/L

k = partial-mix first-order reaction rate constant, day^{-1}

t = total hydraulic residence time in the lagoon system, day

n = number of cells in the series

Comparison with the partial mix model shows that this is the same equation. The only difference between the two models is the reaction rate constant. For complete mix lagoons the recommended complete mix reaction rate constant is 2.5 day^{-1} at 20 ºC (Crites, et. al., 2006). As with the partial mix model, if the lagoons in a system are of unequal size, then the equation must be applied to each lagoon in the series.

Facilities must be provided downstream of complete mixed lagoons to allow removal of settleable solids from the water column. Partial mix aerated lagoons can be provided downstream of a complete mix lagoon to provide a place for solids settling.

4.2.1.3 Mixing in Lagoon Systems

The energy required for mixing in aerated lagoon systems is generally provided by the aeration system. For partial mix systems the aeration system is sized to provide enough oxygen to maintain aerobic conditions and no more. Complete mix systems may require energy input in excess of what is required to maintain aerobic conditions in order to keep solids in suspension. For mechanical aeration systems energy input of at least 30 horsepower per million gallons (hp/Mgal) of lagoon volume is required to keep solids in suspension (Rich, 1999). For diffused air systems a mixing intensity of 10 to 15 standard cubic feet per minute per 1000 cubic feet (scfm/1,000 ft^3) of reactor volume is recommended to maintain completely mixed conditions (Water Pollution Control Federation, 1988).

4.2.2 Aeration in Lagoon Systems

Oxygen requirements in aerated lagoon systems are based on the organic loading entering the cell. Supplying oxygen at a rate of 1.5 times the BOD_5 mass entering the cell has been found to be sufficient to treat the wastewater. The following equation is used to estimate the oxygen transfer rate (Crites, et. al., 2006):

$$N = \frac{N_a}{\alpha\left[\frac{(C_{sw} - C_L)}{C_S}\right](1.025)^{(Tw-20)}}$$

Where N = Equivalent oxygen transfer to tap water at standard conditions (lbs/hr)

N_a = Oxygen required to treat the wastewater (lbs/hr)

α = (oxygen transfer in wastewater)/(oxygen transfer in tap water)

C_{sw} = $\beta(C_{ss})P$ = oxygen saturation value of the waste, mg/L

β = wastewater saturation value/tap water oxygen saturation value = 0.9

C_{ss} = tap water oxygen saturation value at temperature Tw

P = ratio of barometric pressure at the site to barometric pressure at sea level

C_L = minimum dissolved oxygen concentration to be maintained

C_S = oxygen saturation value of tap water at 20ºC and 1 atm pressure

T_w = wastewater temperature, ºC

Oxygen can be supplied to aerated lagoon systems using mechanical aerators or diffused aeration systems. Mechanical aerators are commonly rated by the number of pounds of oxygen the units will supply under standard conditions per horsepower per hour (lbs. O2/hp-hr). Diffused air requirements are calculated using the following equation (Crites and Tchobanoglous, 1998):

$$Q_{air} = \frac{W_{oxygen}}{(AOTE)(O_2)(\gamma_{air})(1440)}$$

Where Q_{air} = Required air flow (ft3/min)

W_{oxygen} = Oxygen requirements (lbs/day)

$AOTE$ = Actual oxygen transfer efficiency, expressed as a fraction

O_2 = Fractional percent of oxygen in air by weight (0.2315)

γ_{air} = Specific weight of air (0.075 lb/ft3 at 1 atmosphere and 20ºC

The oxygen transfer efficiency of a diffused air system is a function of the air bubble size and the depth of the water column. Smaller air bubbles result in higher oxygen transfer efficiencies than larger bubbles, as do diffusers that are set at deeper depths within the water column.

4.2.2.1 High speed floating aerators

High-speed floating aerators are commonly used for aerated lagoon systems. The units consist of a motor and impeller attached to a float. The units are typically anchored to the lagoon shore using cables. High-speed floating aerators are designed to pump water from the lagoon and spray it into the air, allowing oxygen to diffuse into the water droplets. The high-speed floating aerators can be outfitted with draft tubes to enhance deep water lagoon mixing or anti-erosion plates to ensure water is drawn from the surface. Figure 4-3 shows a typical high-speed floating aerator.

Figure 4-3. High Speed Floating Aerator

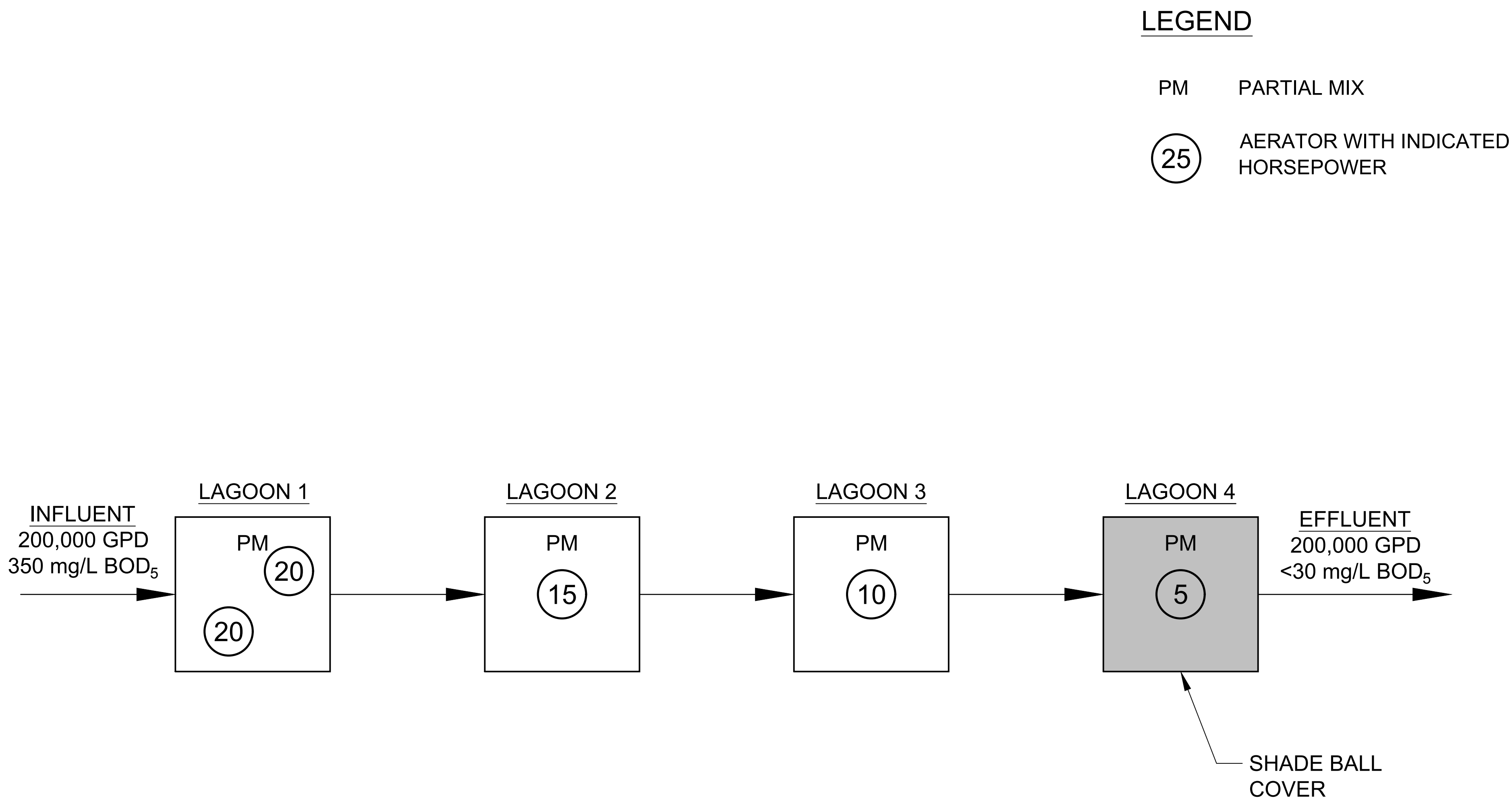
Advantages of this system include low capital costs, relatively high oxygen transfer efficiency, good mixing efficiency, and simple operation and maintenance. The chief disadvantage of the system is the creation of aerosols as the lagoon water is sprayed into the air.

Manufacturers of this type of aerator include Aqua-Aerobics, Aerator Products and Europlec/Aeromix Systems Inc.

High-speed floating aerators are recommended for the Pahala WWTP due to their relatively high oxygen transfer efficiency, low capital cost, and simple operation and maintenance. High-speed floating aerators are easy to remove from service, and can be easily moved between lagoons or cells, if needed.

4.2.3 Aerated Lagoon Configuration

The normal operating condition for the Pahala WWTP will be to operate the four lagoon cells in series as partial mix environments. Figure 4-4 is a schematic representation of the normal operating mode. The fourth cell will be outfitted with a floating cover to preclude algae growth. Having four lagoons will allow the County to take a lagoon out of service for maintenance.



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PAHALA WASTEWATER TREATMENT PLANT

NORMAL LAGOON CONFIGURATION SCHEMATIC

FIGURE 4-4

Table 4-1 summarizes the results of the aeration and mixing calculations for the normal operational configuration treating the design average dry weather flow rate of 200,000 gallons per day. Comparison of the minimum aerator requirements shown in Table 4-1 with the proposed aerator layout shown in Figure 4-4 reveals that the aerator power supplied exceeds the minimum requirements. An aerator control system will be provided that will intermittently turn the aerators on and off in accordance with the operator settings to supply sufficient oxygen to the system.

Table 4-1. Normal Configuration Aeration and Mixing Requirements

Cell	Volume (gal)	Influent BOD_5 (mg/L)	Effluent BOD_5 (mg/L)	Minimum Aerator Requirement (hp)	Mixing Density (hp/Mgal)
1	92,000	350	155	34	37
2	92,000	155	68	15	16
3	92,000	68	30	7	7
4	92,000	30	<30	3	3

4.2.4 Lagoon Liner

Lagoon liners are required to prevent wastewater seepage into the ground. The liner will be exposed to sunlight, so resistance to ultraviolet light (UV) degradation is a key factor in the selection of the liner material, as is the compatibility of the material with typical domestic wastewater characteristics and ease of liner maintenance. Lagoon liner options include high density polyethylene (HDPE), Hypalon, and reinforced polypropylene (RPP), as discussed below. An 80-mil textured high density polyethylene (HDPE) geomembrane is recommend for this application.

Textured HDPE is known to have excellent UV resistance, good chemical resistance, and generally is not affected by fats, oils, and grease (FOG). Maintenance of HDPE requires a specialty contractor who can complete fusion weld repairs. Unlike smooth HDPE, textured HDPE presents minimal slipping hazard to operations personnel. Furthermore, the anticipated useful service of an HDPE liner in typical Hawaii municipal wastewater treatment conditions is 25 to 30 years.

4.2.5 Lagoon Cover

In the normal operating mode the final cell in the lagoon series will be covered in order to deprive algae of sunlight. This will reduce the algae concentration, which can increase TSS levels in the system effluent. The cover should float on the surface of the water, be UV resistant, suitable for windy environments, and allow for rainwater to pass through the cover to prevent ponding. A floating shade ball cover is proposed for this installation.

Floating shade balls covers have been used for decades in in the mining, water and wastewater treatment industries. Figure 4-5 shows the design elements of a typical shade ball, and Figure 4-6 shows how shade balls provide cover on a reservoir. In addition to reducing algae growth, shade ball covers deter waterfowl from storage ponds. The black, UV-stable HDPE resin has known to withstand a range of challenging chemical and environmental conditions. Table 4-2 summarizes technical data for the balls.

Table 4-2. Lagoon Shade Ball Cover Application Parameters	
Requirement	Description
Algae Control	Balls – 90% shade coverage
Temperature	50⁰C to 95⁰C
Wind Resistance	Balls ballasted with potable water tested in winds of 120 mph (category 3 hurricane)
Waterfowl Safety	Waterfowl do not recognize ball-covered pond as a water body and will not nest on the unstable surface
Lifecycle/Warranty	The shade balls are warrantied for 10 years, with an expected resin life of 25+years
Operations and Maintenance	Self-cleaning, self-levelling and require little to no maintenance Balls will move out of the way of maintenance barge, and can be restrained with booms Little installation effort required Precipitation does not affect the cover
Sustainability	Resin is recyclable, paraben free and suitable for drinking water applications Ballast is potable water Resin can be made from recycled plastic
Environment	Balls have been installed in chemically harsh environments (mining industry), in drinking water reservoirs, and in tropical locations Balls reduce algae formation and corresponding disinfectant byproducts in chlorination applications

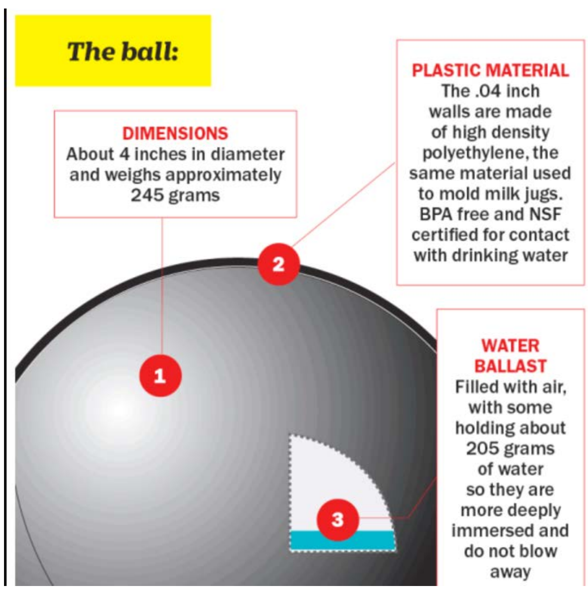


Figure 4-5. Floating HDPE Shade Balls

Figure 4-6. Floating shade balls with current and turbulence in reservoir

4.3 Disinfection

Disinfection processes selectively kill pathogens or renders them incapable of reproduction or harm to humans. Disinfection at WWRFs are employed for the purposes of protection of public health, reduction of organic matter, inorganics, nutrients, odor, aesthetics, and maintaining waste-assimilative capacity of receiving water bodies. The protection of public health through the control of disease-causing microorganisms is the primary reason for wastewater disinfection (WEF, 1996). As the last barrier of protection from pathogenic organisms, disinfection at WWRFs is a very important process. For this application, a calcium hypochlorite tablet system is recommended.

Calcium hypochlorite is the most common solid form of hypochlorite used for disinfection. It can be found as a powder, granules, pellets, or as tablets in concentrations up to 70 percent. Calcium hypochlorite will degrade in strength at a rate of 3 to 5 percent per year. Once applied to the wastewater, the chemistry is similar to that for sodium hypochlorite. Calcium hypochlorite decomposes in an exothermic reaction if exposed to moisture.

The solid can be directly applied to wastewater at very small WWTPs. Figure 4-7 shows a typical calcium hypochlorite feed system.

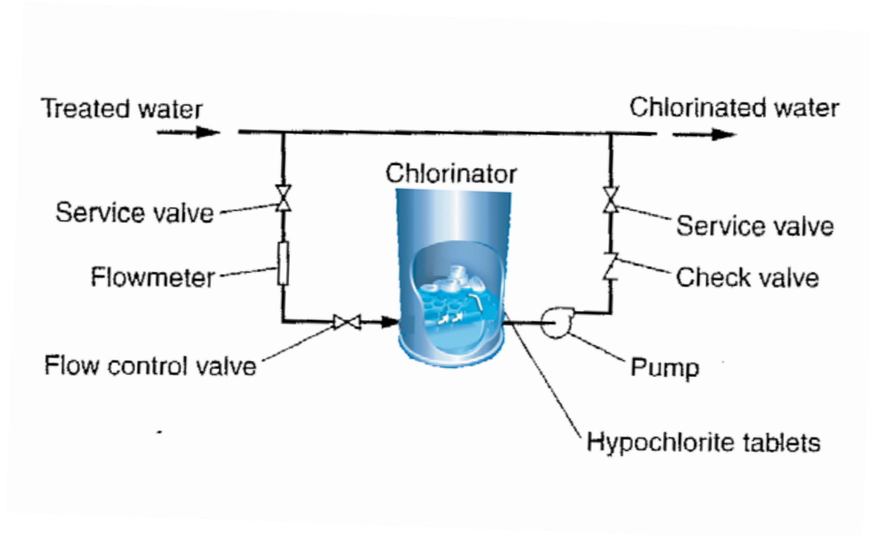


Figure 4-7. Typical Calcium Hypochlorite Feed System

The advantages of using calcium hypochlorite for disinfection at small, remote WWTPs is that it is available in concentrated form as powder, pellets, or tablets. This makes the transportation and storage of disinfectant optimal for small WWTPs. Table 4-3 summaries calcium hypochlorite characteristics.

Table 4-3. Calcium Hypochlorite Summary

Description	Characteristic
Transported Form	Solid
Typical Transported Concentration	70%
Largest transported volume available	55 lb. pails
Decay Rate	Decays 3-5% per year
pH	N/A
Hazards	Toxic if ingested (usually through dust or liquid form)
Storage Constraints	Must be stored in a cool, dry, dark place
Special Equipment	Tablet feeder
Particular Issues	Heats and combusts if not stored properly Scaling in pipes, Off gassing

4.3.1 Dose and Contact Time

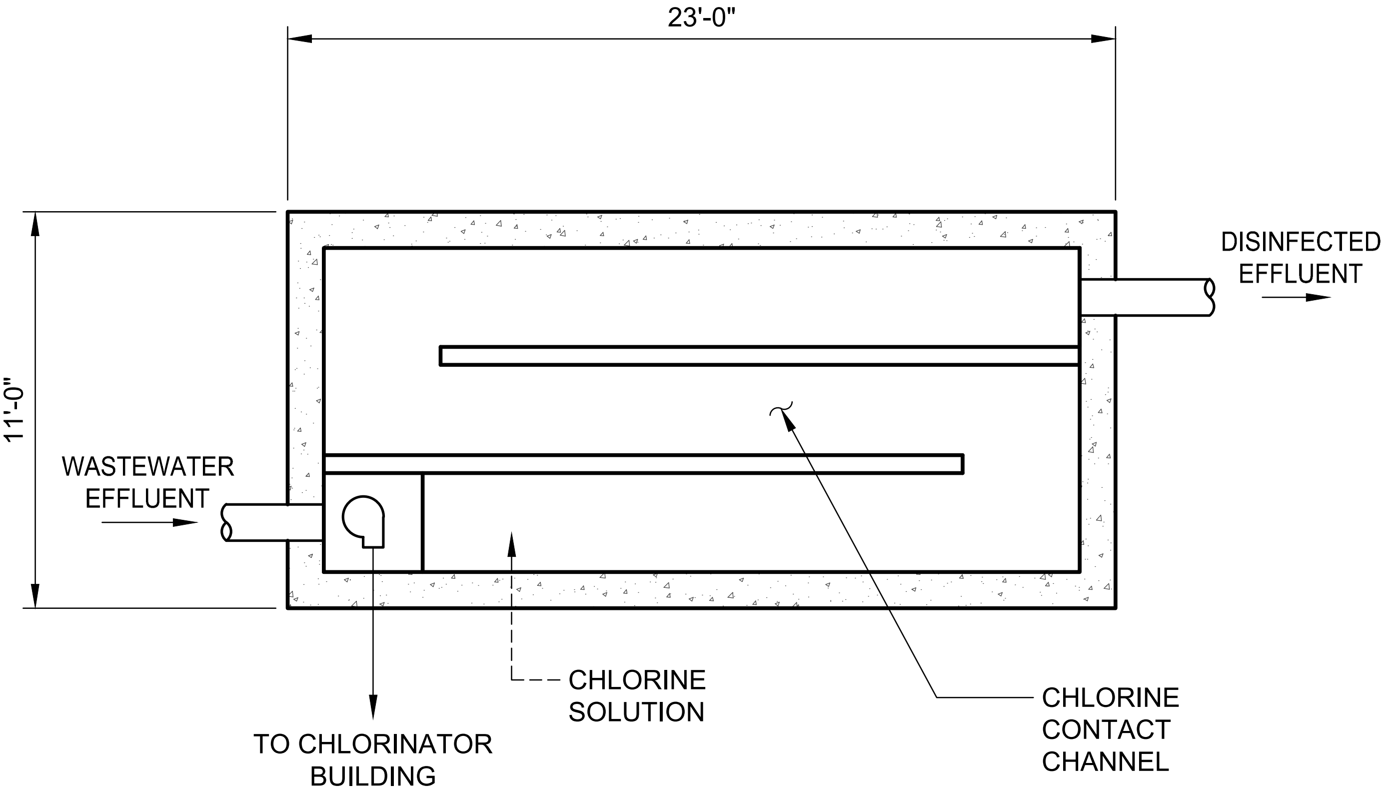
The effectiveness of a chlorination system is highly dependent on the characteristics of the wastewater, the initial mixing and contact time, and the chlorine dose used. For nitrified effluent, the recommended dose is between 8 and 18 mg/L. The WWTP will discharge to a land application system during normal flow and wet weather periods when the secondary effluent will be diluted by precipitation falling onto the overland flow terraces. For planning purposes a 10 mg/L dose was assumed to be sufficient for the WWTP for most circumstances, but equipment will be sized to provide chemical feed at a rate of up to 100 lbs./day, which will ensure an adequate chlorine dose for peak wet weather discharge flows.

Table 4-4 lists the chlorine demand for various flow conditions.

Table 4-4. Chlorine Demand		
Description	Flow	Chlorine Demand
Average dry weather flow	0.20 mgd	17 lbs./day
Peak day wet weather flow	0.662 mgd	55 lbs./day

The recommended minimum contact time for chlorination is 15 minutes (Ten States Standards Wastewater, Recommended Standards for Wastewater Facilities, 1997, Great Lakes – Upper Mississippi River Board of State and Provincial Public health and Environmental Managers). The size of the chlorine contact tank will need to accommodate a 15-minute contact time for the peak discharge rate. For this application the peak discharge rate will be equal to the peak day wet weather flow, due to the flow equalization provided by the aerated lagoons. Table 4-5 summarizes the contact tank dimensions, while Figure 4-8 shows a conceptual contact tank configuration.

Table 4-5. Chlorine Contact Tank	
Description	Value
Peak discharge rate	460 gpm
Minimum chlorine contact tank	15 minutes
Tank volume required	922 cubic feet
Channel water depth	5 feet
Channel width	3 feet
Tank channel total length	62 feet
Tank dimensions including channel walls	9 feet x 23 feet



Brown AND Caldwell	SCALE: Field JOB NUMBER: 150440 DATE: AUGUST 2017	PAHALA WASTEWATER TREATMENT PLANT CHLORINE CONTACT TANK CONFIGURATION	FIGURE 4-8

4.4 Effluent Management

For effluent management, a slow-rate land application system is proposed. The concept is to intermittently apply wastewater to crops growing in permeable soils. As the applied water percolates through the soil matrix or is taken up by the crop, it is treated by physical filtration and by biological mechanisms. After an application period or wetting period, the surface can dry and oxygen can enter the soil matrix, which aids aerobic biological treatment. This frequent wetting and drying also maintains the infiltration rate through the soil surface and minimizes soil clogging. The percolating water from will be dispersed over a large area and allowed to trickle into the groundwater. This application is an effective treatment process for BOD, TSS, trace organics, phosphorus, metals and pathogen removal. Furthermore, removal of nitrogen can be significant when system is managed for that objective.

4.4.1 Design

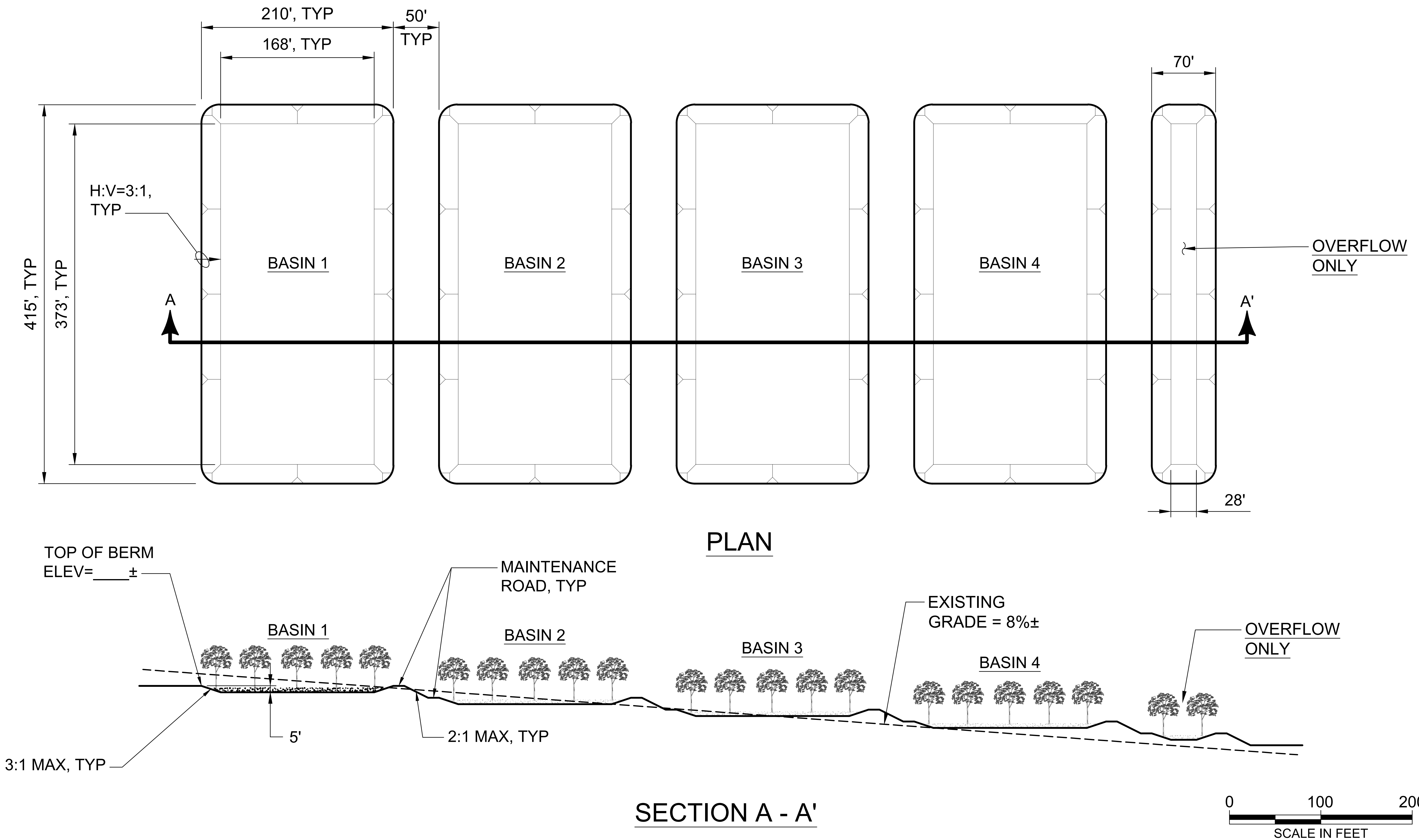
The slow-rate system site consists of a net area of approximately 8 acres. There will be 4 basins, of 2 acres each, so that a fresh basin will be used each day. An additional 1 acre basin will be an emergency (overflow) or reserve basin to be used when basin surface maintenance or distribution system maintenance is conducted. By using one basin per day the wet/dry cycle will be 1 day wetting and 3 days drying.

The basins will be planted with native Hawaiian trees. Trees grown within the land application area will need to be both water and salt tolerant. Table 4-6 lists potential native tree species.

Table 4-6. Potential Land Application System Tree Species

Common Name	Genus Species	Salt Tolerance	Water Requirements	Rubbish and Maintenance	Preferred Elevation
Milo	Thespesia populnea	Very	Dry to Wet	Moderate	Low to Medium
Loulu	Pritchardia hillebrandii	Very	Dry to Wet	Low	Low
Aalii	Dodonaea viscosa	Very	Dry to Medium	Low	Low to High
Kou	Cordia subcordata	Very	Dry to Wet	Moderate	Low
Golden Loulu	Pritchardia arecina	Moderate	Dry to Wet	Low	Low to Medium
Wiliwili	Erythrina sandwicensis	Moderate	Dry to Medium	Moderate	Low

The distribution system will consist of gated piping located on the surface. The piping will have slots to allow the applied wastewater to uniformly be distributed over the basin surface. A perimeter fence will be installed to limit access. Access roads will surround each basin. Figure 4-9 reflects the proposed land application basin schematic.



Path: P:\Projects\Hawaii, County Of (HI)\150440 COH Pahala WWTP_CAD\0-PROJECT\FIGURES Cadd User: Richard Sellona
File Name: 150440-FIG-LandAppSystem Plot Date: August 25, 2017 9:04 AM

Brown AND Caldwell

SCALE: 1" = 100'
JOB NO: 150440
DATE: AUGUST 2017

PAHALA WASTEWATER TREATMENT PLANT

LAND APPLICATION SYSTEM SCHEMATIC

FIGURE
4-9

4.5 Ancillary Systems

4.5.1 Water

Potable water is not currently available at the site. The nearest potable water system is located uphill in town. Table 4-7 provides an initial assessment of the potential water demands at the WWTP. The water demands are either for process or potable uses. As shown in the table, the process water demands are significantly greater than the potable demands.

Table 4-7. Potential Water Demands

Description	Flow Rate	Type	Priority
Screenings washer	20 gpm for 10 min/hour 4,800 gpd	Process	Mandatory with screen
Hose bibs	10 gpm for 20 min/day 200 gpd	Process	Desirable to maintain facility
Emergency eye wash / shower	20 gal per use	Potable	Mandatory
Restroom	20 gpd	Potable	Recommended

To supply water to the WWTP, it is recommended to construct approximately 2000 linear feet of 8-inch pipe from the intersection of Huapala Street and Maile Street to the site and install a 1 inch water meter with 1 ½ inch backflow preventer.

A plant water system will be supplied by the County water meter. The on-site water system will be split into two branches, one for process water and one for potable water. The potable water will service the restroom and emergency eye wash/shower. A second backflow preventer will separate the process water uses from the potable connections.

4.5.2 Access Road

All weather access will be required to operate and maintain the WWTP. Access to the site will be provided by connection to Maile Street. A paved driveway apron is proposed at the north side of the property at Maile Street. The all-weather driveway will extend into the site and provide access to and around the various WWTP infrastructure. Additionally, a turn-around area large enough to accommodate a fire truck will be provided.

Access road pavement options include aggregate base (AB) gravel, asphalt concrete (AC), or concrete. AB is the lowest cost option, but requires the most maintenance. AC pavement is not recommended for steep grades. Concrete is the highest cost option, but is the most durable and requires the least maintenance.

The recommended driveway pavement section is 2 inches of AC over 6 inches of aggregate base course. For portions of the driveway that exceed 10 percent slope, a concrete pavement section is recommended.

4.5.3 Electrical Systems

It will be necessary to bring electrical power to the WWTP site. It is anticipated that Hawaii Electric Light Company (HELCO) will bring overhead power lines to the site and supply 480 volt, 3 phase power to the WWTP via a pole-mounted transformer to a service panel with a meter.

The floating surface aerators will consume the majority of the electricity supplied to the site. An electrical room will house the electrical gear, plant control equipment and the chlorination system. Exterior lighting at the site will be limited to manually switched lights at the entrance to the electrical building and at the headworks area.

A standby power system will be provided in the form of a pad-mounted diesel generator and above-ground fuel tank with capacity to support three consecutive days of operation. In addition, the electrical service panel will be equipped with a manual transfer switch and generator receptacle to allow connection of a trailer-mounted generator in the event of emergency generator failure during an extended power outage.

4.5.4 Telemetry Systems

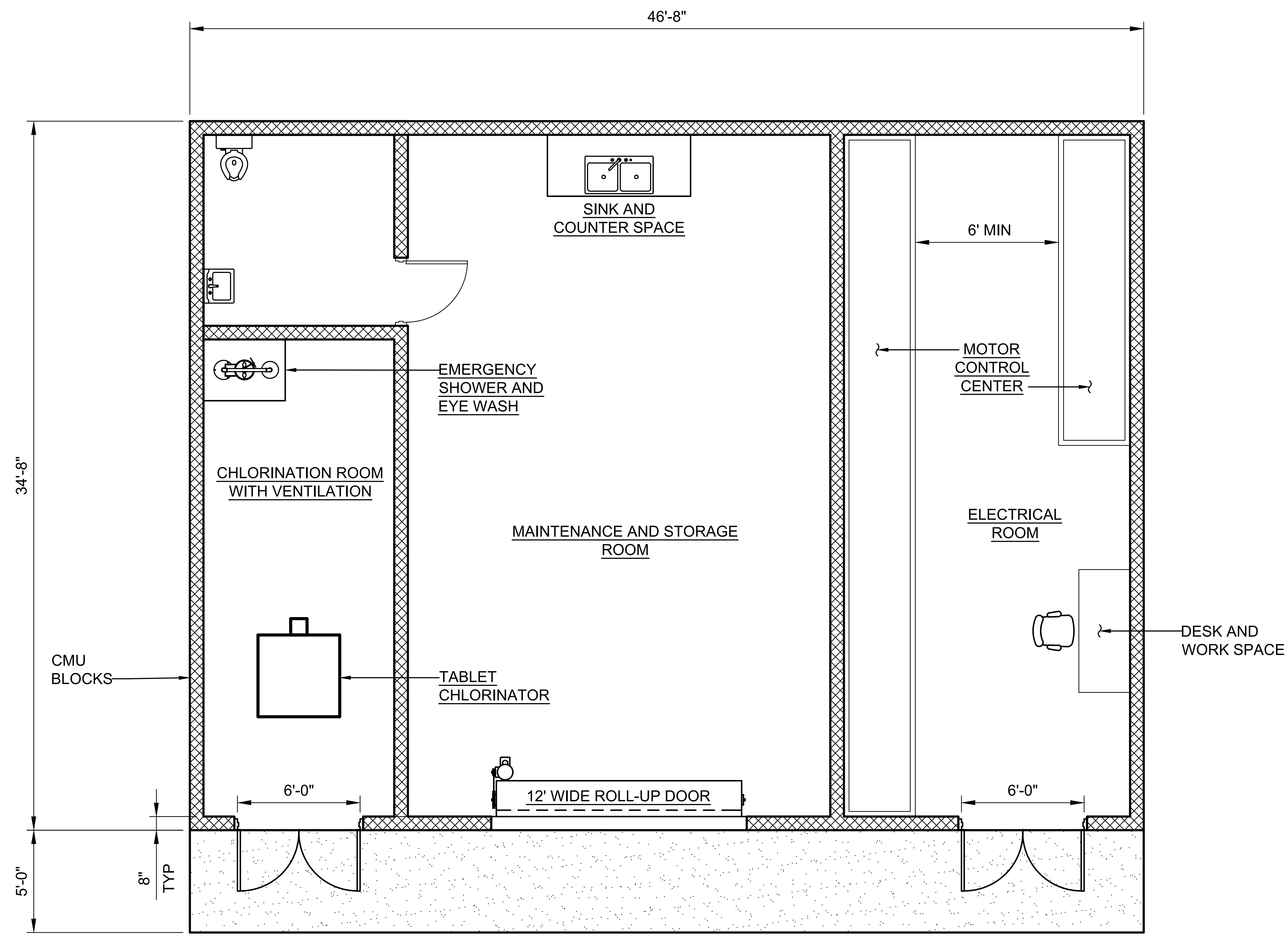
A cellular telephone or land-line telephone telemetry system will be provided to provide Hilo-based operation staff of alarm conditions and key operational parameters at the WWTP.

4.5.5 Operations Building

An operations building will be constructed to include the electrical room, chlorinator room, restroom, and maintenance/storage room, as shown in Figure 4-10.

4.5.6 Site Fencing

The entire WWTP site, including the treatment systems and the land application system, will be fenced and posted to prevent public access.



SCALE: 3/16" = 1'-0"

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File Name: 150440-FIG-OpBldg

Brown AND Caldwell	SCALE: 3/16" = 1'-0" JOB NO: 150440 DATE: AUGUST 2017	PAHALA WASTEWATER TREATMENT PLANT OPERATIONS BUILDING PRELIMINARY FLOOR PLAN	FIGURE 4-10

Section 5

Preliminary Design of Improvements

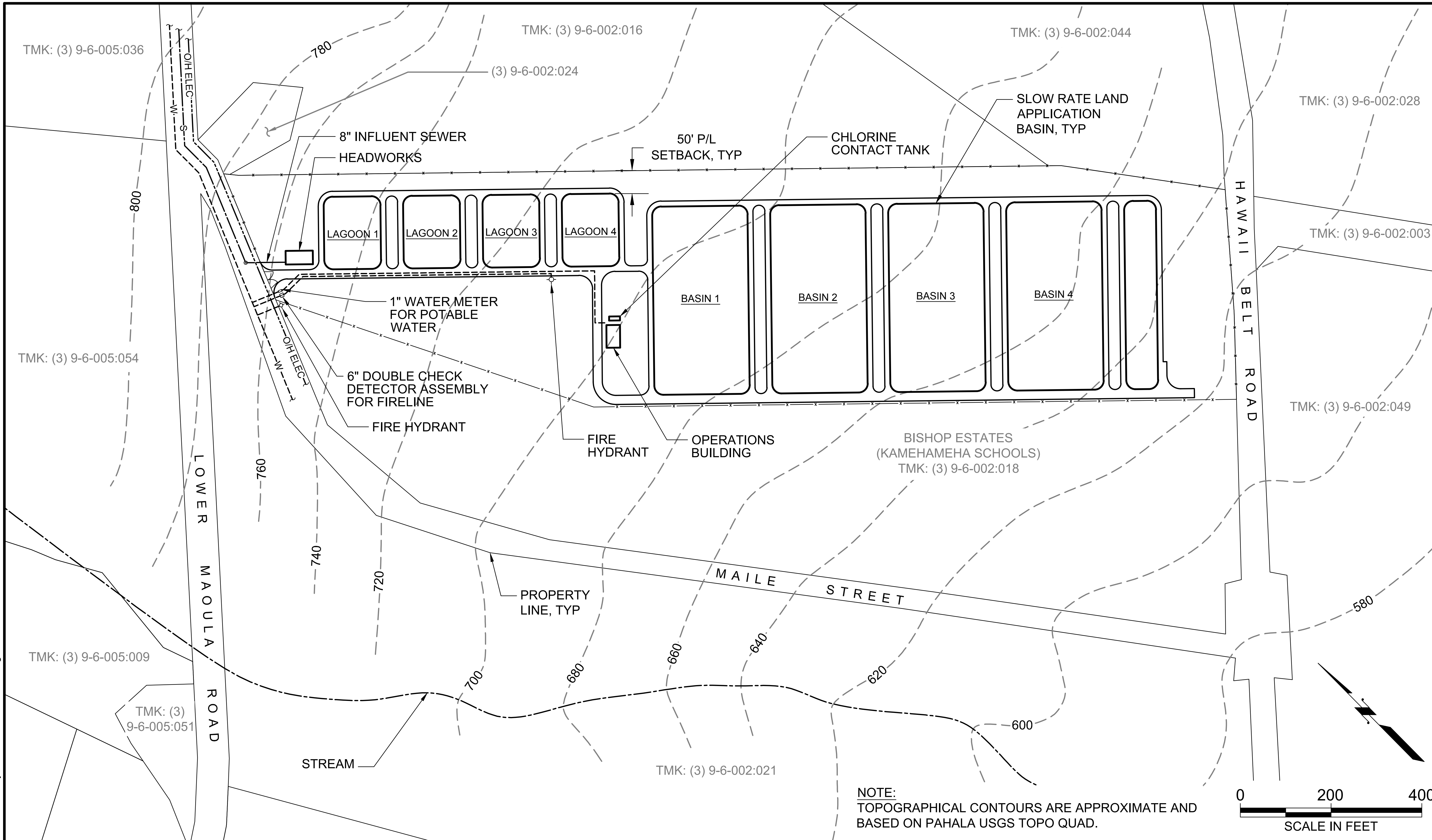
The following is a summary of the preliminary design for the proposed Pahala WWTP.

5.1 Site Plan

The existing site is approximately 25 acres of macadamia nut tree orchard. The prevailing grade is in the north to south direction at 5 to 10 percent slope. Approximately 16 acres of the land will be cleared for the construction of the proposed facility. Figure 5-1 presents a preliminary site plan for the WWTP.

5.2 Process Schematic

Figure 5-2 presents the recommended facilities process schematic.



Path: P:\Projects\Hawaii, County Of (HI)\150440 COH Pahala WWTP_CAD\0-PROJECT\FIGURES Cadd User: Richard Sellona
File Name: 150440-FIG-PreliminarySitePlan Plot Date: August 25, 2017 9:59 AM

Brown AND Caldwell

SCALE: 1" = 200'

JOB NO: 150440

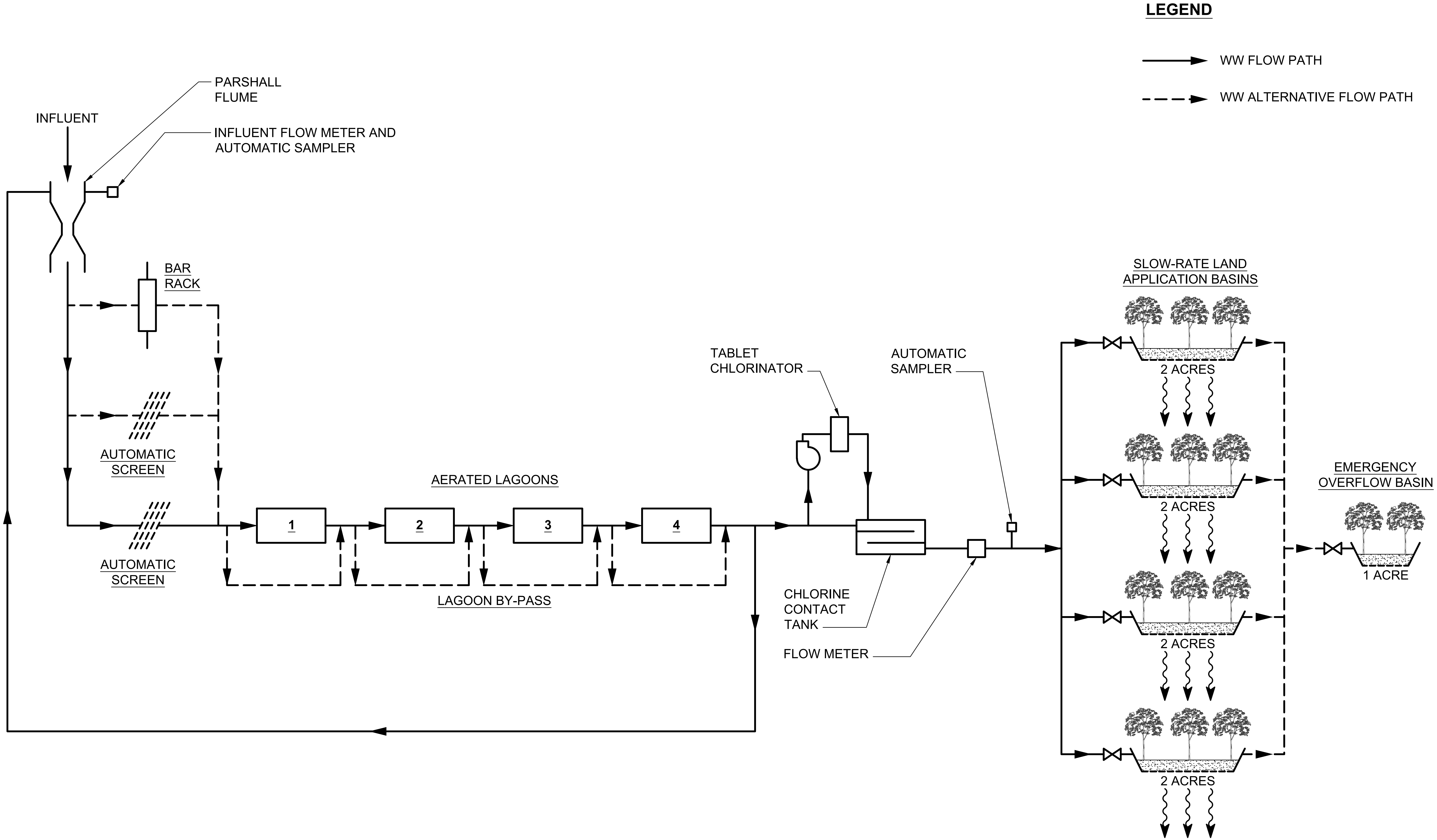
DATE: AUGUST 2017

PAHALA WASTEWATER TREATMENT PLANT

PRELIMINARY SITE PLAN

FIGURE

5-1



Brown AND Caldwell	SCALE: NONE JOB NO: 150440 DATE: AUGUST 2017	PAHALA WASTEWATER TREATMENT PLANT RECOMMENDED FACILITIES PROCESS SCHEMATIC	FIGURE 5-2

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File Name: 150440-FIG-ProcessSchem Plot Date: August 25, 2017 9:07 AM Cadd User: Richard Sellona

5.3 Design Criteria

Table 5-1 provides preliminary design criteria.

Table 5-1. Preliminary Design Criteria

Description	Value
Influent flows:	
• Average dry weather	200,000 gpd
• Peak day wet weather	662,000 gpd
• Peak hour wet weather	625 gpm
Influent characteristics	
• BOD_5	350 mg/L
• TSS	350 mg/L
Mechanical screens	
• Number of units	2
• Type	In-channel cylindrical
• Screen opening size	0.25 inch (6 mm)
• Maximum flow rate capacity	Greater than 625 gpm each
• Screening washing	Integral
• Screening compaction	Integral
• Screening wash water flow	20 gpm
• Screening wash water pressure	50 psi
Bypass screen	
• Type	Manually-cleaned bar rack
• Bar spacing	1 inch
• Rake	Interlocking with bars
Screenings receptacle	
• Type	55 gallon drum or bags
• Screenings per million gallons treated	5 ft^3/Mgal
• Estimated screenings quantity	1 ft^3/day
• Disposal frequency	1/week
Influent flow metering	
• Type	Parshall flume
• Maximum flow capacity	Greater than 625 gpm
• Minimum straight upstream channel section	20 times the throat width
Influent flow sampling	Refrigerated automatic composite sampler
Lagoon cells	
• Number of cells	4

Table 5-1 continued. Preliminary Design Criteria	
• Maximum lagoon temperature	25°C
• Minimum lagoon temperature	20°C
• Freeboard	3 feet
• Working water depth	12 feet
• Allowance for sludge	3 feet
• Total water depth	15 feet
• Side slope	3(H) : 1(V)
• Working volume of each lagoon	0.92 Mgal
Aerators	
• Type	Floating mechanical surface aerators
• Cell 1 aerators	40 hp (2 at 20 hp)
• Cell 2 aerator	15 hp
• Cell 3 aerator	10 hp
• Cell 4 aerator	5 hp aspirator style, floating ball cover for algae control
Disinfection system	
• Type	Chlorine
• Form	Calcium hypochlorite tablets
• Design chlorine dose	10 mg/L
• Chlorine contact time	15 minutes minimum
Effluent flow metering	
• Type	Magnetic
Effluent sampler	
• Type	Refrigerated automatic composite
Effluent management system	
• Type	Slow-rate land application basins
• Number	5 total (4 working, 1 emergency overflow)
• Minimum depth	5 feet
• Design percolation rate	0.0095 inches per minute
• Design application rate	8 percent of percolation rate
• Distribution system	Gated pipe
• Stormwater containment	100-year, 24-hour storm event
• Vegetation	Native Hawaiian trees

Section 6

Implementation

Table 6-1 provides the implementation schedule for the WWTP. The LCCs will be closed following connection of the sewer system to the WWTP.

Table 6-1. Implementation Schedule	
Description	Milestone
Hold initial public meeting with affected community	December 15, 2017
Acquire land for WWTP	July 5, 2018
Complete Environmental Information Document (EID) and submit to USEPA	September 11, 2018
Complete design of WWTP	September 18, 2019
Complete construction of WWTP	May 20, 2021
Connect existing collection system to WWTP	June 30, 2021

Section 7

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